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sudden cardiac arrest during MSHSL [Minnesota State High School League] practice or games and lived, nor does it include SCDs that occurred outside the auspices of MSHSL" (1). Dr. Weinrauch implies that we should be counting deaths that occur "outside of the few hours per week of sports exposure." We are unaware of data to suggest that, when not participating in sports, high school athletes are at greater risk than their nonathlete peers. The data from Corrado et al. (2) found that >90% of SCDs in athletes occurred during sports and nearly 90% of deaths in nonathletes were during sedentary activities. Counting deaths outside of high school sports suggests that we apply electrocardiographic (ECG) screening to all students and view it from a public health perspective. It is important to recall that many more students and athletes die of causes unrelated to SCD (e.g., alcohol and drug, motor vehicle accidents, and suicide) than of SCD. From a public health perspective, it may be wiser to put more capital into preventing those noncardiac causes of death through thorough pre-participation evaluations (PPEs) and developing emergency action plans with automatic external defibrillators for each school.

The denominator in this study is likely the most accurate reflection of MSHSL athlete-years available. The unduplicated athlete number is a summation of 19 years of all athletes. To be included in this pool, an athlete must be cleared to participate with a PPE using a standardized form that was introduced in 1992, coincidentally the first year that the unduplicated athlete number was tracked by the MSHSL, *and* make the limited rosters of one of the high school teams (freshman, B squad, junior varsity, or varsity). In a Venn diagram, there would be an undetermined overlap between the sets of athletes in organized programs and athletes in MSHSL programs. Dr. Weinrauch notes that some students may have had a PPE and made a team, but then not participated; we agree that that is possible, but likely rare. Previous studies of Minnesota athletes by Maron et al. (3,4) and highlighted by Dr. Weinrauch all used participant estimates for the denominators.

We concur with Dr. Weinrauch's call for improved databases to accurately track both the numerator and denominator with regard to sudden cardiac arrest in young athletes, but the numerator and denominator must be concordant to reflect the actual population at risk. We would suggest that the issue be addressed with respect to age groups (6 to 10, 11 to 14, 15 to 18, 19 to 25, and 26 to 35 years of age), sex, ethnicity, and intensity of activity. Using electronic versions of the PPE tied to injury tracking programs may make large-scale studies of interventions such as electrocardiography for cardiac screening plausible. Rather than jumping headlong into ECG screening of all athletes with the accompanying ramifications of false positives and negatives, it would seem prudent to uniformly use standardized PPEs across the country and to begin to study the outcomes in athletes with and without ECG screening.

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Reply

Sudden Death in Adolescent Athletes

It is my pleasure to respond to Dr. Weinrauch's letter concerning our paper (1) because it provides a unique opportunity to highlight some of the broader issues of concern to the sports cardiology community.

Dr. Weinrauch is not alone in his call for a meaningful, well-conducted sudden cardiac death (SCD) registry because many academicians share his concerns related to methodology, choice of correct numerators and denominators in the SCD rate equation, and question of efficacy of electrocardiographic screening in youths and young athletes in the United States (2). To address these concerns, a working group convened in April 2010 by the National Heart, Lung, and Blood Institute (NHLBI) concluded that "this (ECG) debate will continue unresolved until additional, compelling evidence is provided that either supports or refutes the utility of screening for SCD in the young" (1). The group called for an aggressive research agenda, including a prospective registry of SCD in the young.

Although cardiologists have defined standard outcome measures for certain interventions (3), the greater sports cardiology community has not yet done the same for athletic populations. As a result, comparisons among studies are problematic, and debate ensues. Some studies define SCD as death occurring during or within 1 h of exercise in a competitive athlete. Using this definition, Danish investigators reported an SCD incidence of 1.21 per 100,000 person-years in athletes, markedly lower compared with 3.76 per 100,000 person-years among the general population 12 to 35 years of age (4). Alternatively, some studies include sudden cardiac arrests (SCAs) and resuscitated events. In King County, Washington, investigators reported an overall SCA/SCD rate of 2.28/100,000 person-years in the general population of young people 0 to 35 years of age (5). Just 25% of cases occurred during or within 1 h of exercise, suggesting that re-calculation of the SCD rate would bring the figure closer to, if not lower than, the Danish numbers. Well-defined uniform metrics in athletic populations would be of great benefit to the sports medicine and sports cardiology communities and would allow for greater consensus, proper clinical trial design, and the development of proper guidelines. Although resuscitated SCAs certainly qualify as adverse cardiac events, they may not be suitable for the numerator

of the SCD equation because death did not actually occur. Marathon race directors have adopted this approach (6), which has had useful practical application in advising risk of participation, while assisting in event preparation and the best allocation of limited resources.

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Carvedilol Versus Metoprolol, But Which Metoprolol?

Effect on Inappropriate Cardioverter-Defibrillator Therapy

Ruwald et al. (1) studied the benefit of carvedilol versus metoprolol for inappropriate antitachycardia pacing (ATP), using data from the MADIT-CRT (Multicenter Automatic Defibrillator Implantation with Cardiac Resynchronization Therapy) trial. In a following editorial comment, Raitt (2) discusses further the issue of inappropriate ATP. What is most surprising is that neither Ruwald et al. (1) nor Raitt (2) specify metoprolol as the tartrate or the succinate form. This failure to indicate the rapid- or delayed-release forms of the medication when concluding superiority in favor of carvedilol has to be of concern to the reader. The major clinical trial of metoprolol, MERIT-HF (Metoprolol CR/XL Randomised Intervention Trial in Congestive Heart Failure), which showed a significantly decreased all-cause mortality in their heart failure patients, specifically used metoprolol succinate (3). When carvedilol and metoprolol were compared in the COMET (Carvedilol or Metoprolol European Trial) using metoprolol tartrate (target dose, 50 mg twice daily) versus carvedilol (target dose, 25 mg twice daily), the composite endpoint of mortality and all-cause admissions was not significantly different for the 2 medications, although the authors considered that there was a suggestion of carvedilol superiority (4). Obviously, the comparator in the current papers under consideration (1,2) ideally should have been the succinate form of metoprolol, as in MERIT-HF (3).

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Reply

Carvedilol Versus Metoprolol, But Which Metoprolol?

Effect on Inappropriate Cardioverter-Defibrillator Therapy

We thank Dr. Whayne for the interest and questions that he had with regard to our recently published results from the MADIT-CRT (Multicenter Automatic Defibrillator Implantation With Cardiac Resynchronization Therapy) trial (1) and accompanying editorial (2).